

TAP 511- 5: Absorption in biological materials

Closer to home

Relating radiation to risk means thinking about how ionising radiations interact with you and other biological materials. Simple measurements could show you how much the radiation penetrated, and how much energy it deposited in each cubic metre of you.

Although these two are related, you can do a fairly simple sum, based on the energy per particle for a known source, and the activity, to suggest that the sources available to you in the laboratory are very un-likely to produce temperature rises that you can easily measure. So the energy delivered is probably beyond what can easily be achieved in the school laboratory.

Here you measure how the quantity of radiation varies as you alter the thickness of biological materials through which it has to pass. For ethical reasons, use fruit and vegetables.

You will need

- ✓ radiation sensor, beta sensitive
- ✓ samples of fresh fruits and vegetables (marrow, apple etc)
- ✓ an apple corer
- ✓ sharp knife (a plastic one might be advisable)
- ✓ pure beta source and holder
- ✓ forceps or tweezers for manipulating the absorbers

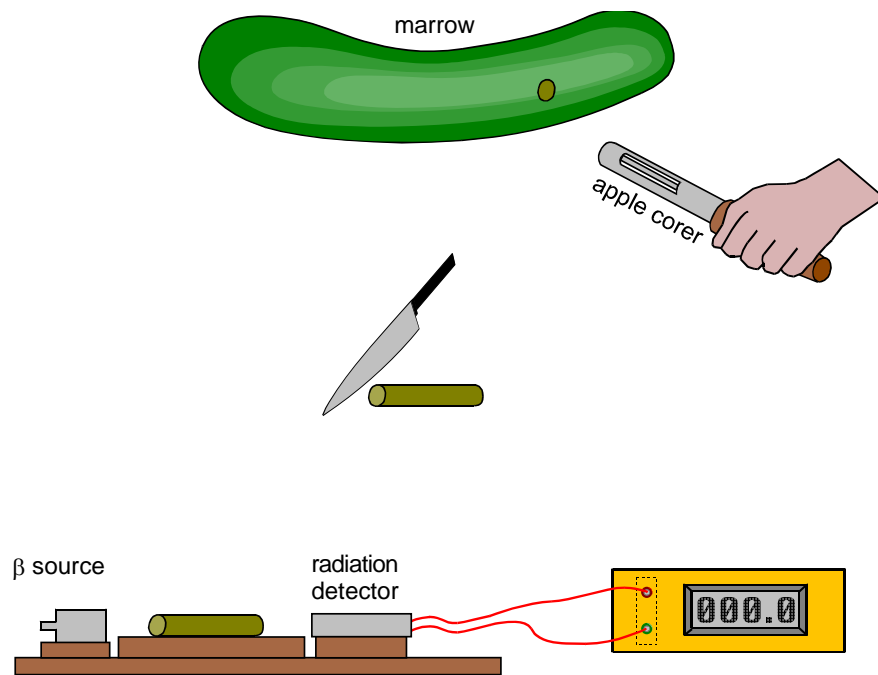


Radioactive sources

Follow the local rules for using radioactive sources, in particular do not handle radioactive sources without a tool or place them in close proximity to your body.

Alignment and arrangement

Take a sample of the fruit, using the apple corer to obtain a cylindrical specimen, then a knife to trim it to length.



Take care to maintain the alignment of the source and detector throughout the experiment. You will probably want to take measurements at both extremes (no absorbing material, maximum thickness) to make sure that you are likely to get a reasonable variation in count rate – this should help you decide appropriate lengths of time over which to take each count.

Now you will probably need to take perhaps 10 readings to establish a reasonable pattern: for 8 cm of absorber, every 0.5 cm might be suitable for your source.

Making sense

See if you can spot a pattern in your results, and then use a sensible analysis to show that the pattern holds. You should draw on other work done on absorption, from chapter 4 onwards, to help suggest likely patterns. Alternatively you may be able to think of sound physical reasons for one pattern. Do not forget about the background count!

Reflections

Try again with another fruit, or compare your results with those of another group working with a different fruit. Look for similarities and differences. Can you draw any conclusions from these? Can you test any hunches that you might have?

You have worked with beta radiation, as it has suitable properties for use in the school laboratory, allowing measurements with the equipment that you have access to. In what ways would you expect the results to change if you used alpha or gamma radiation? (Your expectations should be based on sound physical reasons!)

You have shown

How the count rate varies as beta radiation passes through differing biological tissues.

Practical advice

To keep the alignment constant you might like to make a jig for the source and detector, with a channel to hold the cylinder of fruit between the two. This channel might usefully be plastic, and removable, to allow for cleaning. The design should also not encourage fruit juices to dribble into either the source or detector. The distance between the source and detector should remain constant, in the range 5–10 cm. The denser the specimen, and the more feeble the beta source, the shorter the cylinder you should use.

The fruit or vegetable you choose to use will depend on the season.

Social and human context

Many bags of saline solution, as perhaps a suitable description of many biological systems, might be employed as models for humans – our usual concern when discussing risk. You might use this as an introduction to the appropriateness of some choices, reflecting on the modelling process and its assumptions.

External reference

This activity is taken from Advancing Physics chapter 18, 100E